The value of genotyping in commercial environments for effective use of genotype-environment interactions

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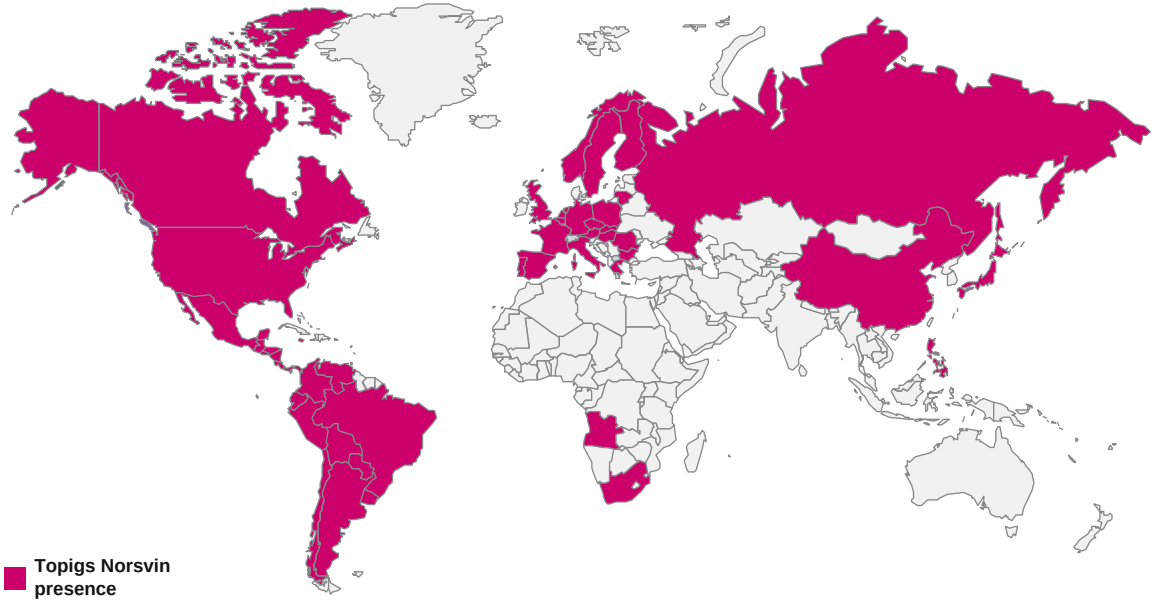
Topigs Norsvin

PROGRESS IN PIGS

Selection in nucleus and distribution in a variety of commercial environments



Genotype-environment interactions are rather inevitable …

Goal

- **Maximize performance in client herds**

Questions

- **How large is the GxE and what is the effect ?**
- **Can we use GxE as a solution rather than a problem?**
- **Can more genotyping in commercial environments help ?**

Higher GxE for some traits than others

	Genetic correlation
# total born	0.83
# stillborn	**0.47**
# dead before 3w	**0.67**
litter wt. after 3w	**0.72**
var. piglet wt after 3w	0.84

Higher GxE for some traits than others

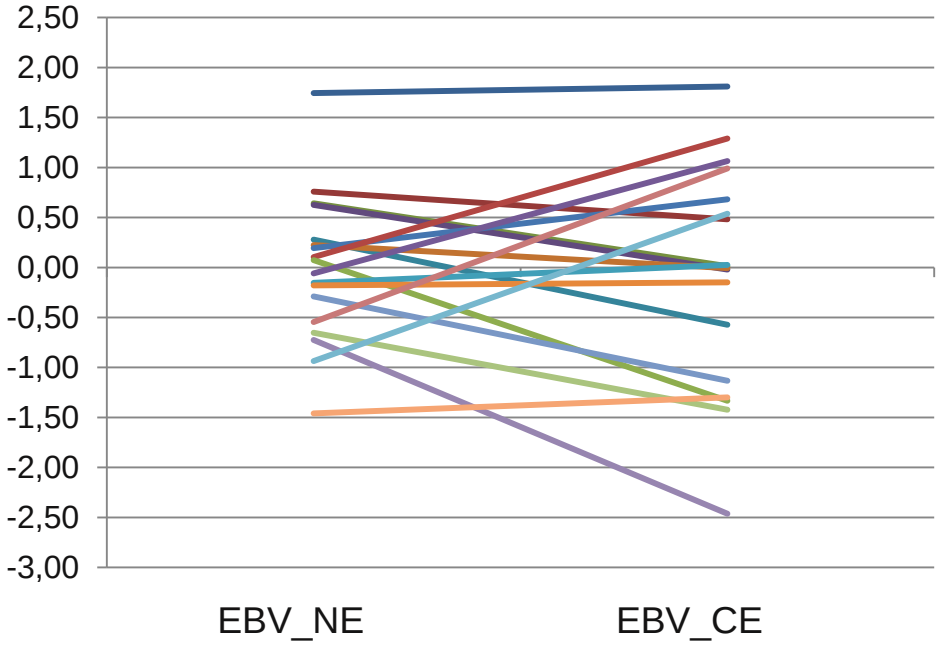
	Genetic correlation	Heritability	
		Nucleus	Commercial
# total born	0.83	0.08	0.11
# stillborn	**0.47**	0.06	0.14
# dead before 3w	**0.67**	0.05	0.15
litter wt. after 3w	**0.72**	0.12	0.18
var. piglet wt after 3w	0.84	0.06	0.06

Higher genetic variation in commercial environment

	Total number born	
Component	**Nucleus**	**Commercial**
Animal	0.95	**1.38**
Litter	0.15	0.11
Permanent	0.85	1.01
Residual	9.27	10.22
Phen	11.21	12.72
Heritability	0.08	0.11

Sire breeding values in nucleus and commercial env.

Total Number Born (EBV)



GxE

Some change in the sire rankings…..

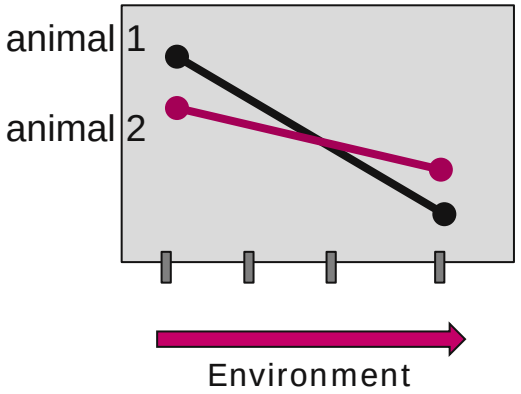
Models accounting for GxE

Genotype GxE

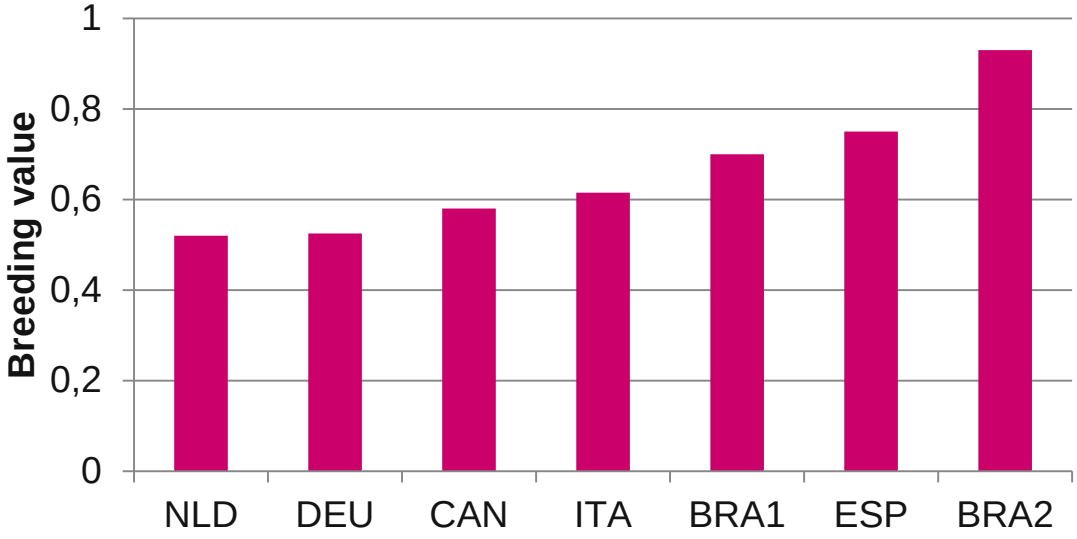
y = fixed effects… + animal + animal.**env.** + other random effects + e

Environment

- Heat stress
- Seasonal variation
- Disease challenge
- Quality of management and other factors



Breeding value according to commercial environment



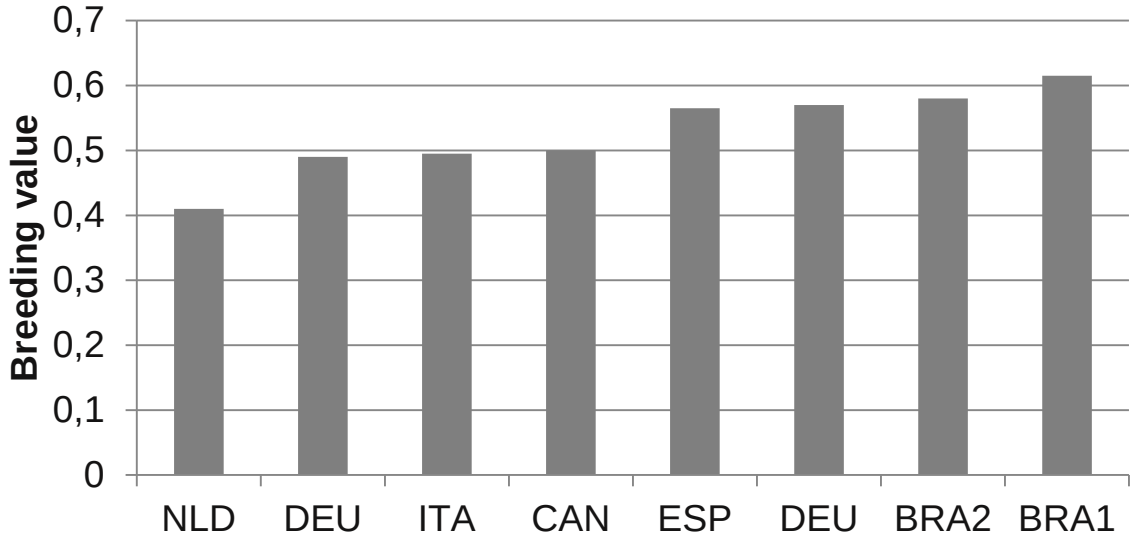
Temp. (ºc)	22.1	22.2	23.3	24	25.7	26.7	30.3

Total Number Born

Measure of environment:
Heat load

Solutions
animal = 0.5,
animal.env= 0.05

Breeding value according to commercial environment



Avg. TNB	16.3	14.7	14.6	14.5	13.2	13.1	12.9	12.2

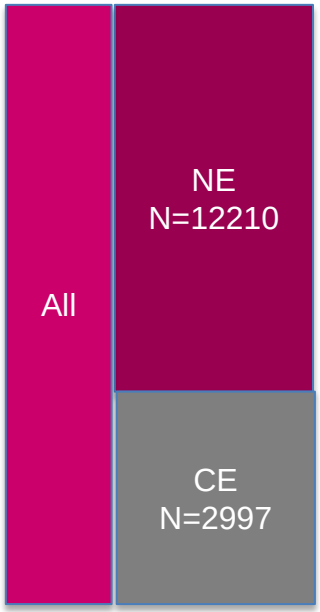
Total Number Born

Measure of environment:
Avg. performance

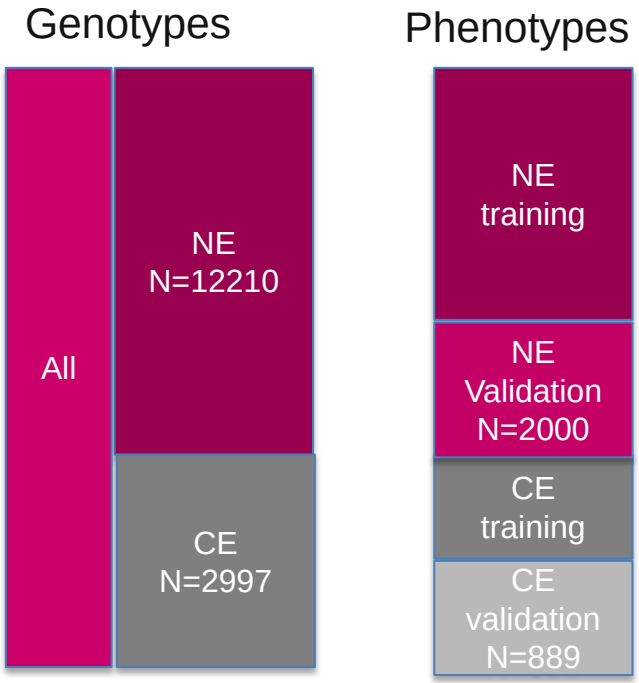
Solutions
animal = 0.5,
animal.env= -0.05

Genotyping information

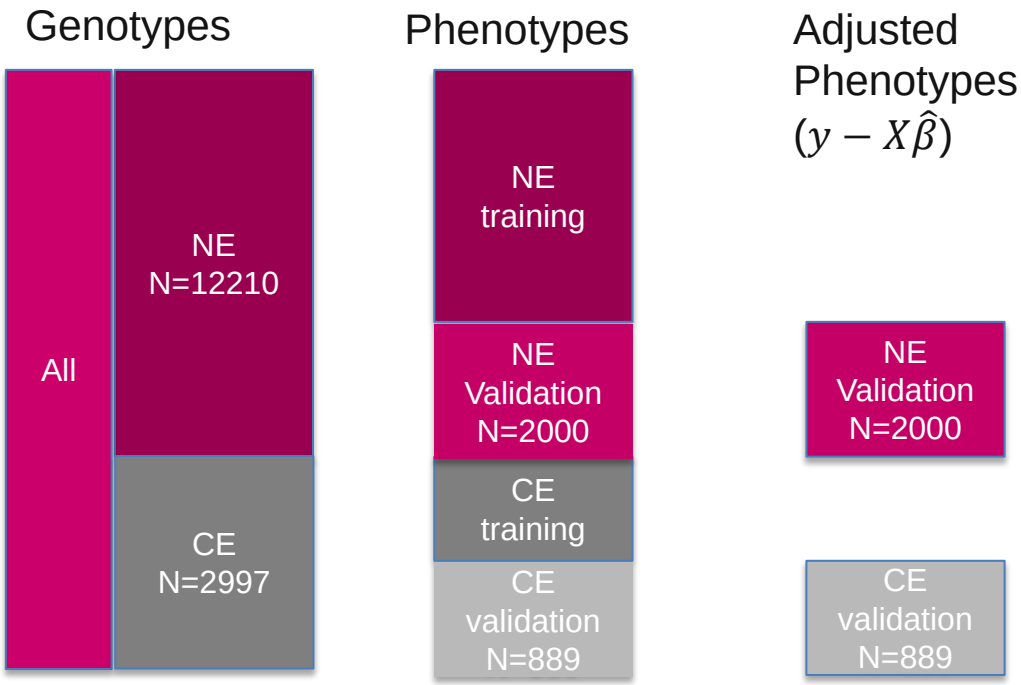
Genotypes



Genotyping information

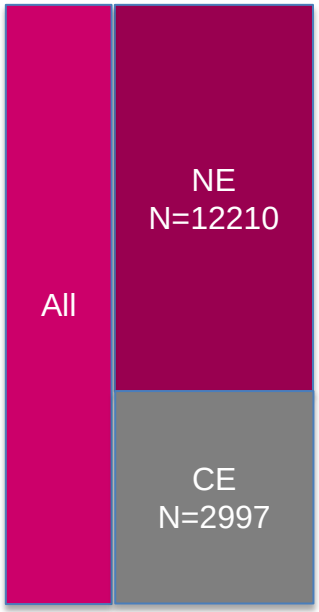


Genotyping information



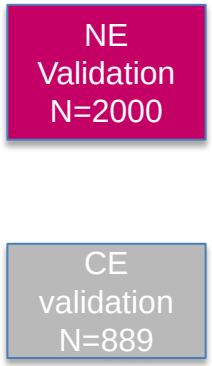
Genotyping information

Genotypes



Phenotypes

Adjusted Phenotypes $(y - X\hat{\beta})$



Accuracy of prediction

$$r = \frac{\mathrm{Fru}(\hat{u}, y - X\hat{\beta})}{h}$$

$\hat{u}$ = GBV from training

h = Square root of heritability

Accuracy in commercial environment with and without genotypes from commercial env.

	without	with
# total born	0.58	0.67
# stillborn	0.52	0.67
# dead before 3w	0.57	0.81
litter wt. after 3w	0.50	0.71
var. piglet wt after 3w	0.58	0.86
average	**0.58**	**0.77**

Accuracy in commercial environment with and without genotypes from commercial env.

	without	with	%increase
# total born	0.58	0.67	16
# stillborn	0.52	0.67	29
# dead before 3w	0.57	0.81	42
litter wt. after 3w	0.5	0.71	42
var. piglet wt after 3w	0.58	0.86	48
average	**0.58**	**0.77**	**33**

Accuracy in nucleus environment with and without genotypes from commercial env.

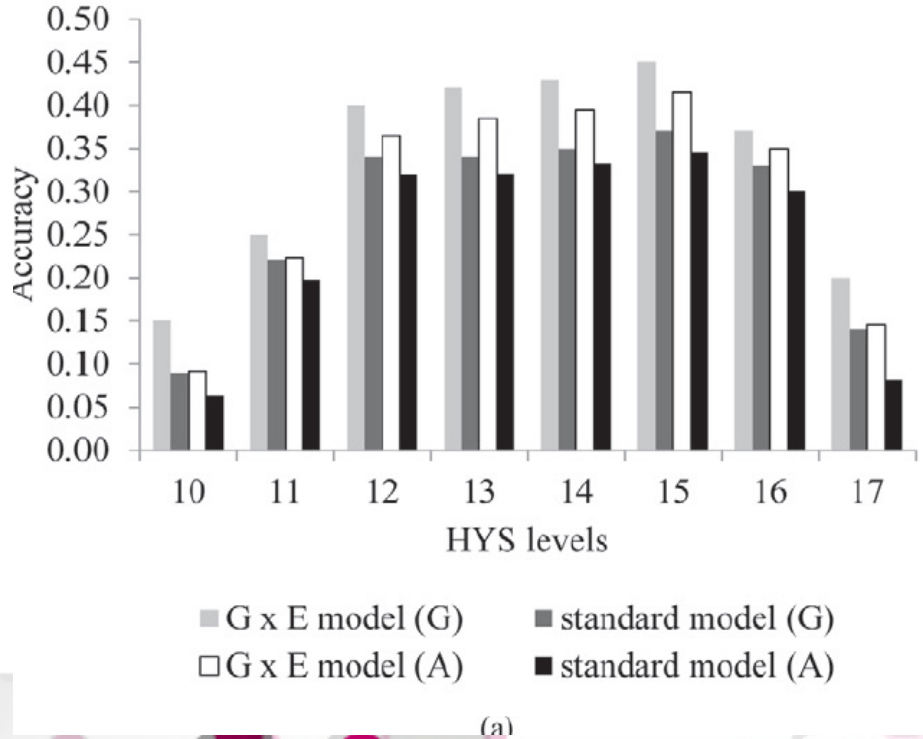
	without	with
# total born	0.55	0.58
# stillborn	0.53	0.54
# dead before 3w	0.66	0.71
litter wt. after 3w	0.86	0.88
var. piglet wt after 3w	0.73	0.74
average	**0.64**	**0.66**

Accuracy in nucleus environment with and without genotypes from commercial env.

	without	with	%increase
# total born	0.55	0.58	5
# stillborn	0.53	0.54	2
# dead before 3w	0.66	0.71	8
litter wt. after 3w	0.86	0.88	2
var. piglet wt after 3w	0.73	0.74	1
average	**0.64**	**0.66**	**3**

Models accounting for GxE

Total Number Born



Genomic reaction norms

Silva et al., 2014

Conclusions

- GxE exists between nucleus and commercial environments, smaller for some traits and larger for others

- Breeding structures and genetic evaluation method should be adapted to maximize performance in commercial environments

- Genotyping and phenotyping in commercial environments can help in enhancing accuracy of breeding value estimation

Thank you !

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PROGRESS IN PIGS

Correlation between GBVs with and without genomic information from CE for selection candidates NE

		Number of records	
	Correlation	Nucleus	Commercial
# total born	0.93	9,374	6,378
# stillborn	0.90	9,374	6,378
# dead before 3w	0.95	8,695	1,525
litter wt. after 3w	0.98	9,058	1,958
Var. piglet wt after 3w	0.97	9,101	1,721
shoulder soar	0.87	9,028	3,377
body condition score	0.92	9,028	3,377